3.17 AUTOMATIC GAIN CONTROL (AGC)

The AGC function normalizes the radar input signal because the dependence of signal strength on radar cross section and range must be eliminated to extract the desired angle error information. A representative AGC circuit supports this objective by holding the mean value of the output at a fixed reference level.

AGC circuits fall into three categories:

a. In continuous functions, the received and amplified signal is rectified and used to control the gain of the amplifier. This type of AGC is employed in all *RADGUNS* receivers.

b. Instantaneous AGC functions use some portion of the detected signal pulse as a negative feedback to immediately control the gain of the receiver. This type of AGC can be selected as an option by the *RADGUNS* user via the JAMMING inputs for the GUN DISH radar only.

c. Logarithmic AGC receivers, in which the received signal output is essentially the logarithm of the input signal, are not implemented in the radar systems simulated by *RADGUNS*.

Figure 3.17-1 depicts a continuous response AGC system. The processing time of the low pass filter introduces lag in the response. To assess the regulation of a finite AGC model with test data, the amplifier gain curve parameters (A, B, C), the low pass filter time constant, and the reference voltage must be comparable.

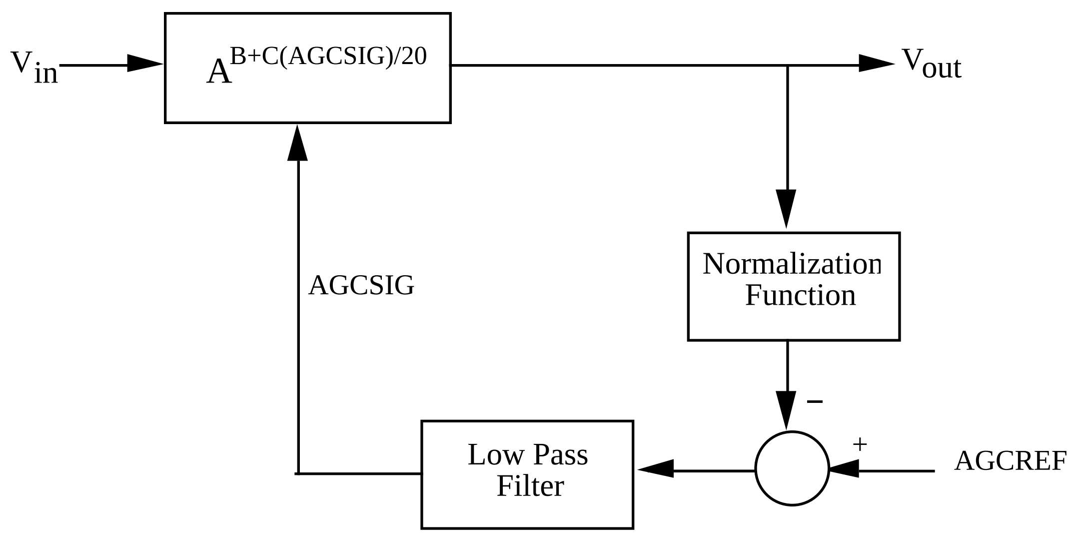

FIGURE 3.17-1. Automatic Gain Control (AGC).

Data Items Required

Data Item		Accuracy	Sample Rate	Comments
4.2.1	AGC reference	±1%	SV/T	
4.2.3	Tracking range	±5 m	10 Hz	
4.2.3	Tracking azimuth	±0.1 deg	10 Hz	
4.2.4	Tracking elevation	±0.1 deg	10 Hz	
4.2.5	Dynamic range	±1%	SV/T	
4.2.6	Signal in	±0.5 dB	100 Hz	Limit to 10 s intervals
4.2.7	Signal out	±0.5 dB	100 Hz	Limit to 10 s intervals

3.17.1 Objectives and Procedures

Both the AGC control voltage and the receiver gain are sensitive to varying target signal levels for fixed AGC reference voltages. In addition, they are sensitive to changes in AGC reference voltage. The range and angle tracking functions are also sensitive to changes in AGC reference voltage.

RADGUNS was exercised with the following input conditions:

a. Model mode: SNGL/RADR
b. Target RCS: 1.0 m^2
c. Target altitude: 200 m
d. Flight path: LINEAR
e. Guns: Disabled
f. AGC reference: 0.5, 0.75, 1.0 (nominal), 1.5
g. Output: Tracking errors, AGC control voltage, receiver gain

3.17.2 Results

In each of the figures below, the target made ingress from 15,000 m at an offset of 500 m. The target crosses over at approximately 75 s.

Figure 3.17-2 shows the effect of AGC reference voltage (AGCREF) on AGC control voltage (AGCSIG). For varying input levels, the AGC attempts to maintain the output of the receiver at a constant level set by AGCREF. It does this by controlling the gain of the receiver amplifier (GAIN0) with AGCSIG. As the input increases (the target makes ingress), AGCSIG increases for a given reference voltage. AGCSIG is a negative feedback control signal. If the reference voltage decreases, AGCSIG must increase to maintain a lower constant receiver output.

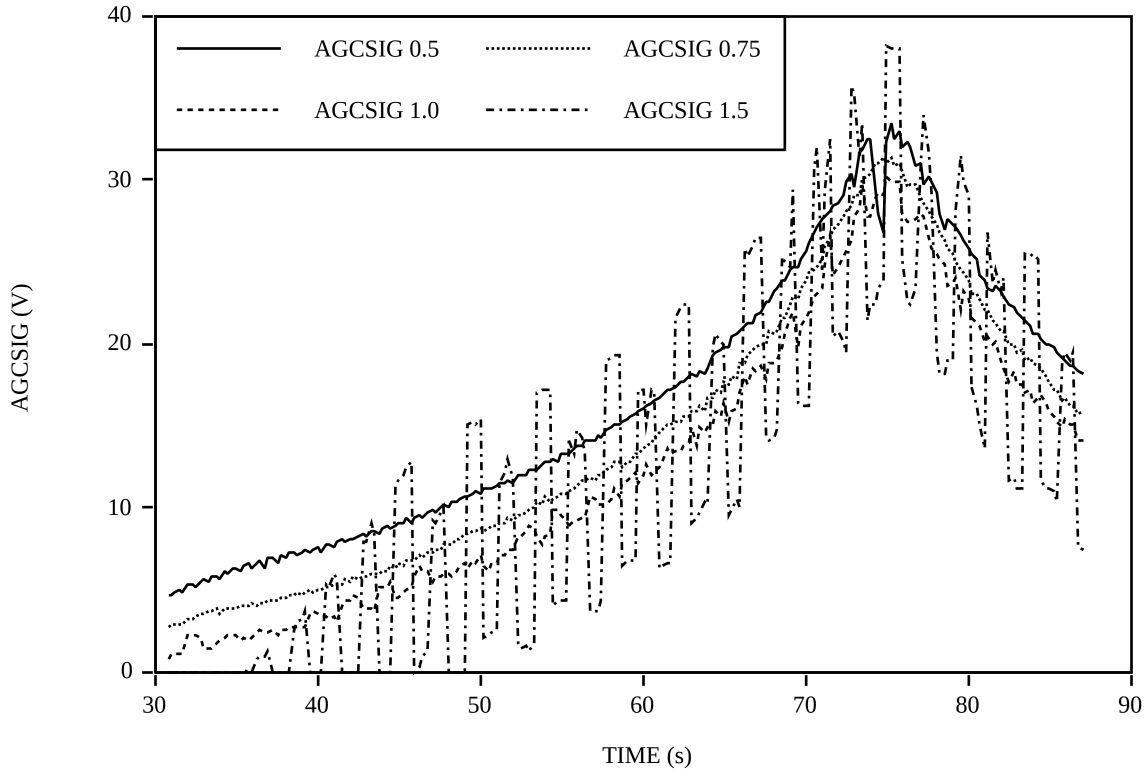

FIGURE 3.17-2. Effect of AGC Reference Voltage on AGC Control Voltage.

The voltage AGCSIG is negatively fed to the receiver amplifier where it is used to decrease gain as the target signal increases (as the target makes ingress). Figure 3.17-3 displays the effect of AGC reference voltage on the receiver amplifier gain (GAIN0). As the reference voltage decreases, a lower gain is needed to hold the output constant. A 50% increase in AGC reference causes the receiver amplifier to become unstable, while a 50% decrease causes the gain to vary approximately 30%.

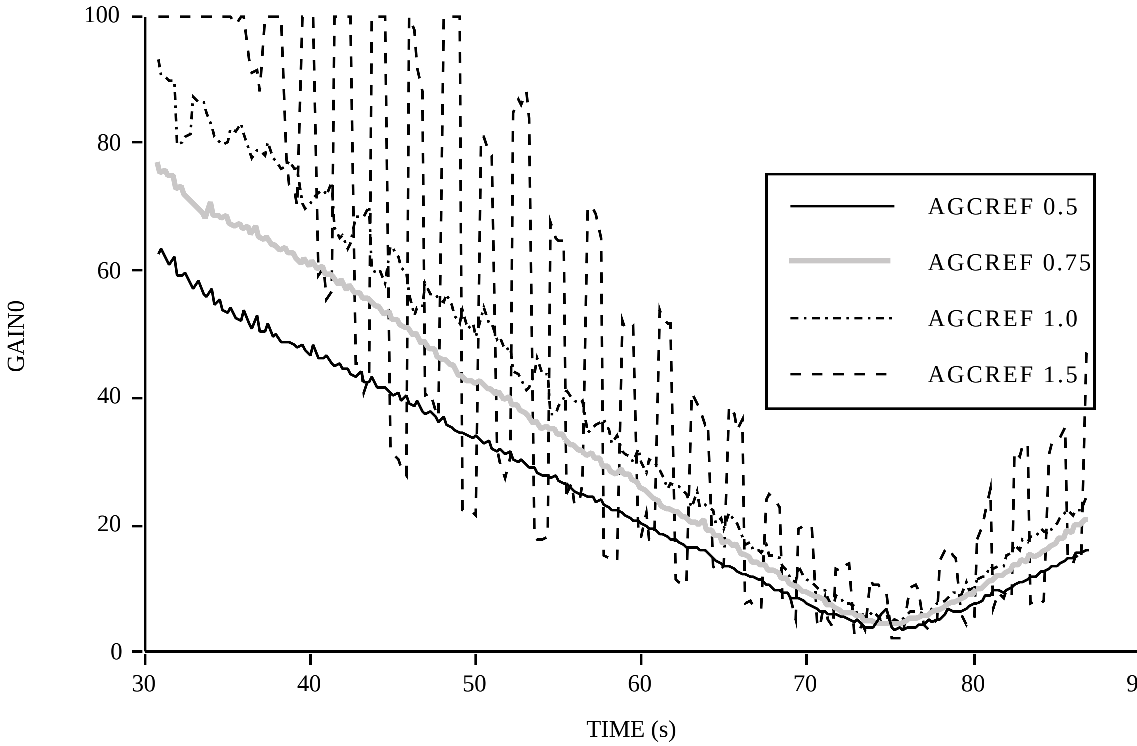

FIGURE 3.17-3. Effect of AGC Reference Voltage on AGC Control Voltage.

3.17.3 Conclusions

The AGC reference voltage affects tracking errors as shown in Figures 3.17-4 through 3.17-6. For angle track, a decrease in the AGC reference voltage causes both azimuth and elevation tracking errors to increase. The decrease in reference voltage also slows the response. The angle tracking errors are outlined in Table 3.17-1.

TABLE 3.17-1. Angle Tracking Errors as a Function of AGCREF.

AGCREF	Mean Azimuth and Error Range (mrad)	Mean Elevation and Error Range (mrad)
0.5	–2.44±17	0.64
0.75	–0.42±10	1.09
1.0	0.23	0.27
1.5	0.74	0.05

A 50% increase in reference voltage triples the azimuth tracking error, but these values are less than one milliradian in magnitude and are thus insignificant. For elevation, the 50% increase actually drives tracking error toward zero. A 50% decrease in reference voltage, however, causes an increase in azimuth tracking error of over an order of magnitude. Decreasing reference voltage by 25% quadruples elevation tracking error; a 50% decrease results in only doubling the error.

When applying a 50% increase in voltage to the range function, a slight decrease in tracking error occurs. A decrease in voltage also results in a slight reduction in tracking error absolute value. These results are listed in Table 3.17-2.

TABLE 3.17-2. Range Tracking Errors as a Function of AGCREF.

AGCREF	**Mean RG Error and Error Range (m)**
0.5	–0.61±3
0.75	0.47
1.0	0.84
1.5	0.69

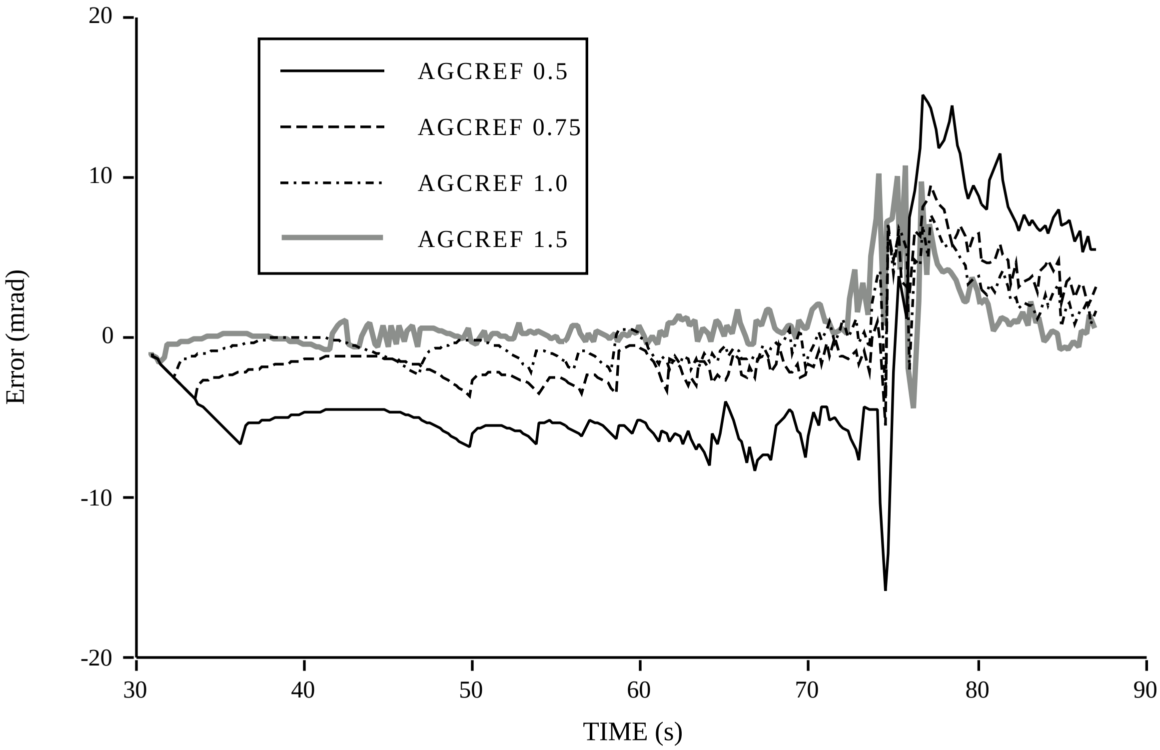

FIGURE 3.17-4. Effect of AGC Reference Voltage on Azimuth Tracking Error.

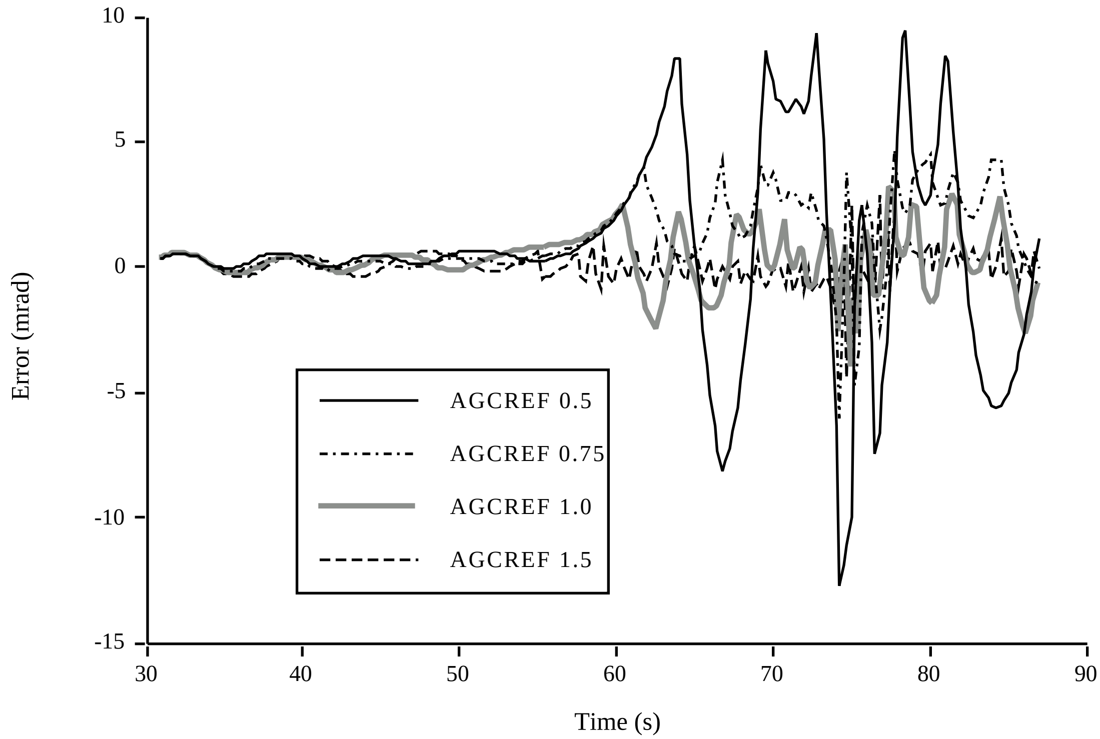

FIGURE 3.17-5. Effect of AGC Reference Voltage on Elevation Tracking Error.

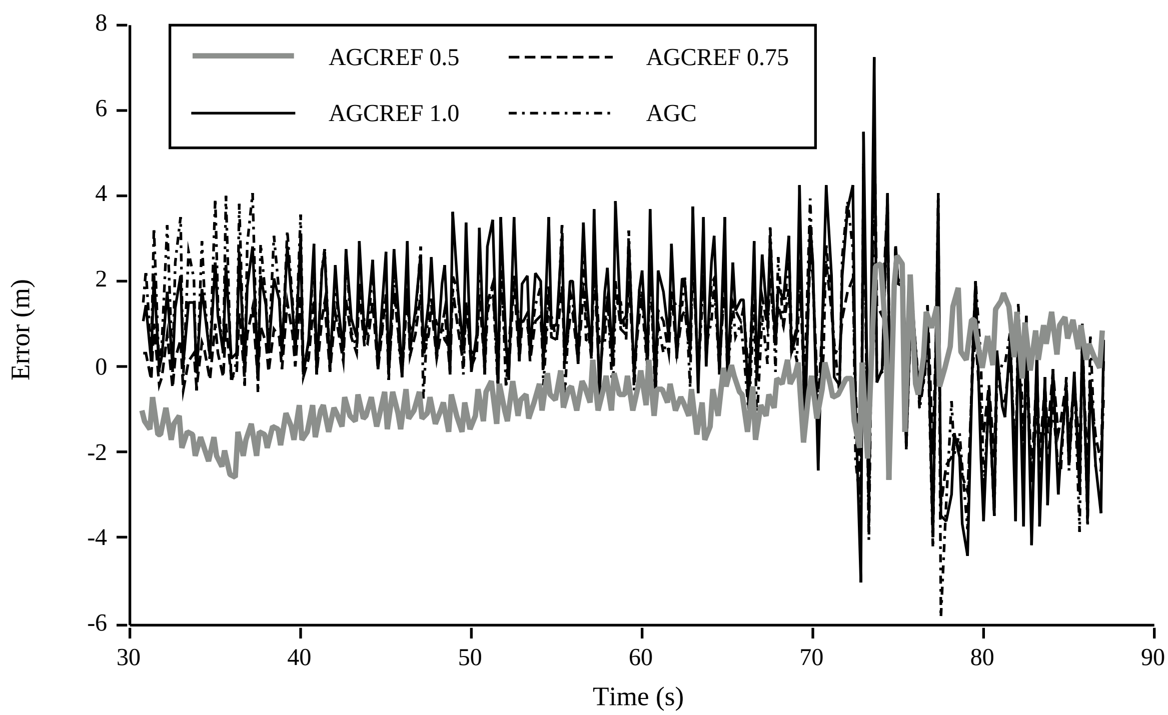

FIGURE 3.17-6. Effect of AGC Reference Voltage on Range Tracking Error.